HUMAN FACTORS ASSESSMENT OF THE TELIDON AVIATION BRIEFING SYSTEM (TABS): SUMMARY REPORT

Ministry of
Transportation and
Communications
Ontario

TC-86-03

HUMAN FACTORS ASSESSMENT OF THE TELIDON AVIATION BRIEFING SYSTEM (TABS): SUMMARY REPORT

Prepared by:

Norman Park
Norpark Computer Design

Project Manager:

Robert M. Rosenbaum
Human and Social Factors Office

Prepared for:

Operations and Technology Office
Communications Division

Published by:

Human and Social Factors Office
Strategic Policy Secretariat
Ontario Ministry of Transportation and Communications
1201 Wilson Avenue
Downsview, Ontario M3M 1J8

Hon. Ed Fulton, Minister
D. G. Hobbs, Deputy Minister

June 1986

ISBN: 0-7729-1008-1
TC-86-03

Acknowledgments

This report was prepared under the direction of Dr. Robert Rosenbaum, Human and Social Factors Office at the request of the Operations and Technology Office, Communications Division. The involvement of the Human and Social Factors Office in the overall assessment is gratefully acknowledged, including the clear direction of Dr. Eileen Simon, the guidance and advice of Dr. Gordon Hemsley, the preliminary work of Mr. Chris Blamey and the background and editorial assistance of Mr. Norman Turner. The assistance of members of the Telidon Aviation Briefing System Advisory Group is also gratefully acknowledged, specifically Mr. R.P. Bulger and Mr. J.J. Bond, Communications Division, Ministry of Transportation and Communications; Mr. F. Dimond and Mr. C.S. Kemp, Air Navigation System Requirements, Transport Canada; and Mr. L. Berthelot, Atmospheric Environment Service, Environment Canada.

Successful completion of this project would not have been possible without the cooperation of Mr. Bill Taylor and Mr. Mike Woods of Transport Canada; Meteorological and Environmental Planning Limited; and the management, staff, and pilots at the Maple, Buttonville, Brampton, Guelph, and Waterloo-Wellington airports.

Special thanks should be given to Dr. Ron Elliott, Mrs. Denise Moretto, Dr. Paul Muter, Dr. Wayne Stevenson, and Ms. Judith Sutcliffe, who worked with Norpark Computer Design Inc., for their help in many aspects of the project.

Table of Contents

List of Figures

1.0 Executive Summary

This report summarizes the main results of a human factors assessment of the Telidon Aviation Briefing System (TABS) conducted during a two-year trial in 15 southern Ontario airports. A modified version of TABS is currently available and additional changes are being planned. With TABS, pilots learn about weather conditions and obtain other relevant aviation information by using a terminal linked to a central computer. TABS was introduced to supplement weather briefing services in which experts provide pilots with relevant aviation and weather information tailored to their needs.

The assessment is based on three main components: an examination of background information, a survey of TABS users and non-users, and an empirical assessment of how effectively pilots can brief themselves using TABS.

The main results and conclusions from each of these components are summarized in this report. The final section considers the results as a whole and makes a series of recommendations listed below that are aimed at improving the design, development, and implementation of safe, effective and efficient aviation weather services.

The first part of this assessment involved obtaining background information necessary to understand TABS and the two other major aviation weather services, the AES and FSS telephone services. Background information included the content and format of the weather information provided by each service as well as descriptions of relevant operational characteristics. The Background Report also clarified the requirements for subsequent components of the human factors assessment of TABS.

The TABS User Survey was designed to obtain feedback from TABS users and from non-users regarding their use of, and attitudes toward TABS and other aviation weather briefing services. The sample included 164 pilots of which 46 were non-users. Users varied considerably in frequency of TABS use, age, licence type, flying frequency and type of aircraft. Non-users knew very little about TABS; this result suggests that non-users are unaware of the service rather than avoiding it.

The surveyed TABS users indicated that the introduction of TABS had reduced their frequency of using the other weather information services and had reduced the percentage of times they received no weather briefing before flying. Pilots indicated that TABS is used most frequently by itself but that sometimes it is used in combination with the other weather information services. Pilots prefer to use TABS compared to other briefing services when preparing to take a local flight, for flight training, or to obtain some information about weather conditions, but there is no clear preference when planning an intinerant flight or when making a go/no go decision.

The overall reaction to TABS is favourable, with 69% of users rating it good or excellent. There are also positive ratings of the type of information available, the format of the pages, the features that affect interactions with the system and the electronic and printed support materials. Concerns were expressed, however, about the timeliness of the information, the speed of the system, the lack of personal contact, the hours of operation, and the need to wait in line.

In comparison with the telephone briefing services, TABS receives similar ratings in terms of usefulness, amount and type of information,

ease of use and the time to begin a briefing session. Phone services are rated higher in the accuracy and timeliness of information, time to learn the system, briefing time and reliability.

Pilots were given a list of 19 potential enhancements and asked to indicate the extent to which each enhancement would encourage or discourage their use of TABS. The five enhancements rated as "very much" encouraging use were the ability to file a flight plan using TABS; the ability to obtain a printed copy of weather information; an automatic warning if the filed flight plan may involve risk; the ability to use TABS from home; and displays that show the movement of weather systems.

The following enhancements were also rated as likely to encourage use: briefings tailored to specified routes; TABS terminals in more airports; information for Canada and North America; additional radar sites; the ability to use TABS from business locations; computer-based refresher courses; and the ability to select three upper-level winds.

The Study of Pilot Performance investigated in a controlled situation to what extent pilots can use TABS to make good, informed decisions as compared to pilots who use audio-taped briefings that are tailored to their needs.

A total of 40 pilots participated in the experiment. The pilots had a wide range of flying skills and had used TABS at least five times. Each pilot was given a single briefing. Half the pilots briefed themselves using a simulated TABS system; the other half received an audio-taped briefing tailored to their needs.

In making a go/no go decision, pilots in both the TABS and tailored briefing conditions were able to make decisions that agreed reasonably

well with the decisions of experts for all weather conditions tested in the experiment. However, when asked a series of basic weather aviation questions related to their flight, pilots in the TABS condition had substantially less detailed information relevant to a hypothetical, itinerant flight than pilots in the tailored condition.

Pilots using the simulated TABS system also took substantially longer to brief themselves than pilots in the tailored briefing condition.

The report concludes tentatively that pilots using TABS may make reasonably effective go/no go decisions, but they may not have all the detailed information they require to effectively plan or execute their flight. It is proposed that TABS users may have difficulty in selecting and/or remembering information relevant to their intended flight. This explanation leads to a discussion of the potential benefits of tailored briefings as a TABS option, paper copies of TABS information pages as a memory aid and computer-assisted instruction in the use of TABS.

Consideration of the results as a whole leads to conclusions that are related to the following issues: accessibility and use of aviation weather services, information and features provided by TABS, performance of pilots using TABS, the time it takes to obtain a briefing using TABS, system performance of TABS, and tradeoffs that need to be considered when planning future work with TABS. Based on these conclusions, the final section of this report presents the following ten recommendations aimed at improving the design, development and implementation of safe, effective, and efficient aviation weather services:

Recommendation 1. Establish a planning and priorities committee whose

primary responsibilities are a) to develop and implement a systematic and coordinated method for considering future options for TABS and b) to decide what effects these options would have on the safety, effectiveness, and efficiency of aviation weather services. Factors considered by the committee would include relevant policy considerations, funding requirements and limitations, tradeoffs, human factors, and technical feasibility.

Recommendation 2. Where it is not already being done, establish performance criteria related to the operation of aviation weather briefing services, and develop and implement procedures for ensuring compliance. Areas where standards are required would include: accessibility, information content, accuracy of information, and timeliness.

Recommendation 3. Consider the following potential improvements and enhancements to TABS:

- tailored briefings as an optional feature;
- ability to file a flight plan through TABS;
- automatic warning if a filed flight plan would expose the pilot to unacceptable risks;
- ability to obtain a paper copy of any TABS page during the self-briefing process;
- displays showing the movement of weather systems;
- SA/FT pages that present information in standard, non-abbreviated English to substitute for or complement current SA/FT pages;
- weather information for Canada and the U.S.A.;
- weather information from additional radar sites; and

- weather information related to upper level winds.

Recommendation 4. Consider improved methods for training pilots to use TABS and other briefing services (e.g., incorporating optional user feedback into briefing, and computer-assisted instruction).

Recommendation 5. Consider methods for improving the responsiveness of TABS (e.g., faster access to service and shorter time to display complex pages). The evaluation should consider the impact on total briefing time, on effectiveness of the briefing and on the tendency to use TABS.

Recommendation 6. Consider increasing accessibility of TABS by installing terminals in more airports and by allowing home, business or airport access through personal computers.

Recommendation 7. Consider initiatives to increase awareness and use of TABS and to improve pilot understanding of the nature of the briefing service it provides.

Recommendation 8. Consider the following potential improvements to the telephone briefing services:

- a separate telephone number for filing flight plans only;
- telephone access to tailored audio-taped briefings so that briefers do not have to repeat the same briefing to several different pilots; and
- a queue feature so that pilots can call a service once and be served in order (while waiting, pilots could hear a brief message regarding the availability of TABS and could be given an estimate of how long they may have to wait for a telephone briefing).

Recommendation 9. Consider continued evaluation of the effectiveness of

TABS and of any potential improvements to the system. One goal of this research would be to provide a better understanding of how pilots use TABS to brief themselves, to plan their flights, and to make decisions during a flight.

Recommendation 10. Consider continued efforts to identify and assess the safety, effectiveness, and efficiency implications of current and potential future briefing services.

2.0 Introduction

For pilots to operate their aircraft safely, effectively and efficiently, they must anticipate weather conditions. In Canada, Atmospheric Environment Service (AES) and Flight Service Stations (FSS) provide aviation weather briefings to pilots either over the telephone or in person.

A new aviation weather briefing service called the Telidon Aviation Briefing System (TABS) is now undergoing a two-year trial in southern Ontario airports. A modified version of TABS is currently available and additional changes are being planned. With TABS, pilots brief themselves by using a terminal linked to a central computer.

TABS was developed in response to a dramatic increase in demand for weather information from pilots, resulting from a tenfold increase in the number of airplanes since 1952. As of August 1983, there were approximately 25,000 airplanes in Canada, of which about 6,000 were based in Ontario.

The greater Toronto region has an especially large volume of aircraft traffic. Within 60 km of Toronto there are 4,000 pilots, 1,100 aircraft, and 41 airports. There are an estimated 1,100,000 takeoffs and landings annually in this area.

At the request of the Operations and Technology Office, the Human and Social Factors Office contracted Norpark Computer Design Inc. to conduct a human factors assessment of TABS. The main objective was to determine to what extent TABS can effectively provide weather information as a supplement to the other aviation weather services. The other objective was to recommend ways of making TABS more effective.

This human factors assessment of TABS is based on three main

components: an examination of available background information and preliminary discussions with appropriate sources, a survey of TABS users and non-users and an assessment of how effectively pilots can brief themselves by using TABS.

Section 3.0 describes each component and how the overall assessment was coordinated. Section 4.0 describes TABS and its relation to other aviation weather services. Section 5.0 summarizes the findings from each component. Section 6.0 draws conclusions and section 7.0 makes recommendations.

3.0 Major Components of the Human Factors Assessment of TABS

The first part of this assessment involved obtaining background information necessary to understand TABS and the two other major aviation weather services, the AES and FSS telephone services. The Background Report was based on interviews with pilots and briefers, available studies of the use of telephone briefing services, ongoing quality assurance studies of TABS and observations of how telephone and TABS services are delivered. Background information included the content and format of the weather information provided by each service as well as descriptions of the following relevant operational characteristics: the nature of the pilot-system interaction, the accuracy of the information provided, the availability of the services, the time required to obtain a briefing, and the types of pilots who use these services and their reasons for using them. This information is presented in a report titled Human Factors Assessment of the Telidon Aviation Briefing System (TABS): Background Report, which is available from the Human and Social Factors Office. The Background Report also contains a series of conclusions which are summarized in section 5.1.

The Background Report also clarified the requirements for subsequent components of the human factors assessment of TABS. Specifically, it identified features of aviation weather services and characteristics of pilots that would require consideration when developing the survey of TABS users and allowed for an improved design for the pilot performance study.

To learn about pilots and their attitudes toward TABS, a user survey was conducted in the summer of 1985 involving 164 pilots of which

46 had not used TABS. The survey identified strengths and weaknesses of TABS and discovered which changes pilots thought would increase their use of the service. A detailed report of this survey, titled Human Factors Assessment of the Telidon Aviation Briefing System: TABS User Survey, is available from the Human and Social Factors Office and is summarized in section 5.2.

Finally, an experiment was conducted which investigated how effectively pilots could use TABS to obtain information needed for a decision about whether to fly (a go/no go decision). In addition, the experiment investigated whether pilots using TABS could obtain the detailed weather information required to plan a hypothetical flight. A detailed description of this study is contained in a report titled Human Factors Assessment of the Telidon Aviation Briefing System (TABS): Study of Pilot Performance, available from the Human and Social Factors Office. This study is summarized in section 5.3.

4.0 Description of TABS and Other Aviation Weather Services

The nature of pilot-TABS and pilot-AES/FSS interactions are illustrated in Figures 1 and 2. Figure 1 (on page 15) represents schematically the pilot-TABS interaction. The pilot is represented on the left side of that figure. Information from the terminal is seen, it is processed, decisions are made, and then actions are taken; for example, the pilot will write down some information or type a response on the keyboard.

The right side of Figure 1 represents TABS. The terminal, a color monitor capable of displaying Telidon code, is connected via telephone lines to a computer containing the TABS user database. Information entering this database comes from the storage and generation database which is updated from external sources. Some data may be modified by software or by hand before they enter the user database. The information available to pilots is stored in the form of pages that are continually being updated. These pages consist of text, graphics or a combination of both.

If a pilot wants a fairly complete briefing about weather conditions, he can select option 1 on the "Welcome" page and obtain a standard sequence of pages describing the current and forecast weather conditions and other relevant aviation and weather information.

The second way a pilot can use TABS is by deciding what information is needed and selecting the TABS pages containing that information. To use TABS in this way, the pilot selects option 2 on the "Welcome" page. The pilot gains access to the desired pages either by using keywords or by choosing the appropriate item from a series of menus.

Figure 2 (on page 16) represents the pilot-FSS (or pilot-AES)

system. The left side of the figure represents the pilot and the right side represents FSS or AES. Unlike the pilot-TABS system, where the pilot interacts directly with a computerized database, when the pilot telephones either the FSS or AES, he talks to a briefer about his information needs. When the briefer understands these needs, he or she decides what information the pilot requires, retrieves the necessary information from the aviation weather database, and presents it in an organized and understandable form over the telephone.

The pilot-briefer interaction varies considerably from briefing to briefing. Some pilots, especially those who are highly experienced, prefer to control the dialogue. They have very specific information requirements, and may resist attempts by the briefer to introduce other pertinent information they have not requested. Other pilots, often those who are less experienced, prefer the briefer to control the dialogue and tell them what they need to know to plan their flight. Briefings also vary in duration from long, detailed area briefings to a quick update on the current weather conditions at a particular airport.

An additional characteristic of the pilot-briefer interaction has to do with the division of responsibility between the briefer and the pilot. The briefer is responsible for providing weather and related information in an organized and understandable fashion to the pilot. The pilot is responsible for communicating his information needs and for making decisions about his flight. It is within the mandate of the briefer to point out weather conditions that present a hazard to a planned flight, although the pilot has ultimate responsibility for the flight and may choose to ignore the information supplied by the briefer.

Briefers may act as a safety net by informing a pilot about hazardous weather conditions that the pilot did not seem to take into consideration. This sort of interaction between the briefer and pilot should be kept in mind because of its important safety implications.

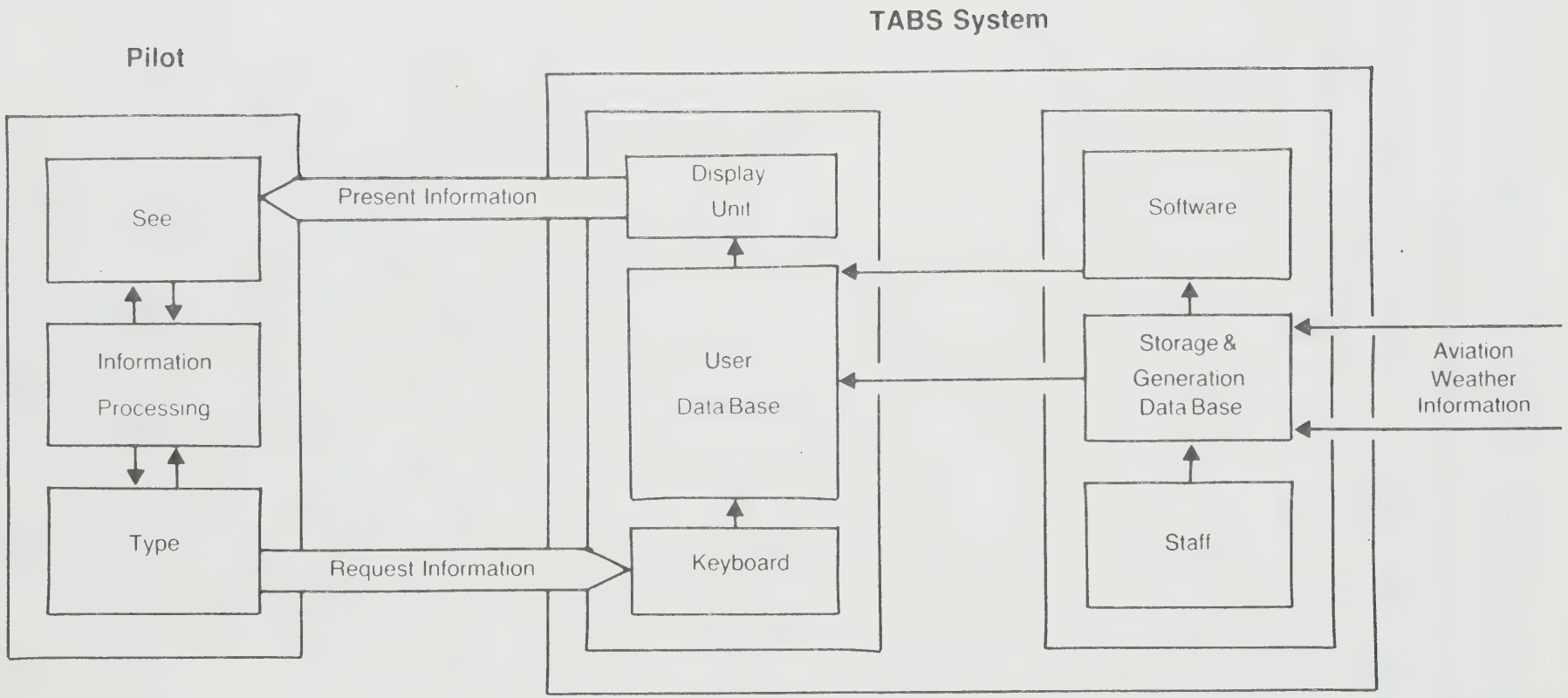

Figure 1. Schematic diagram of self-briefing as provided by the Telidon Aviation Briefing System.

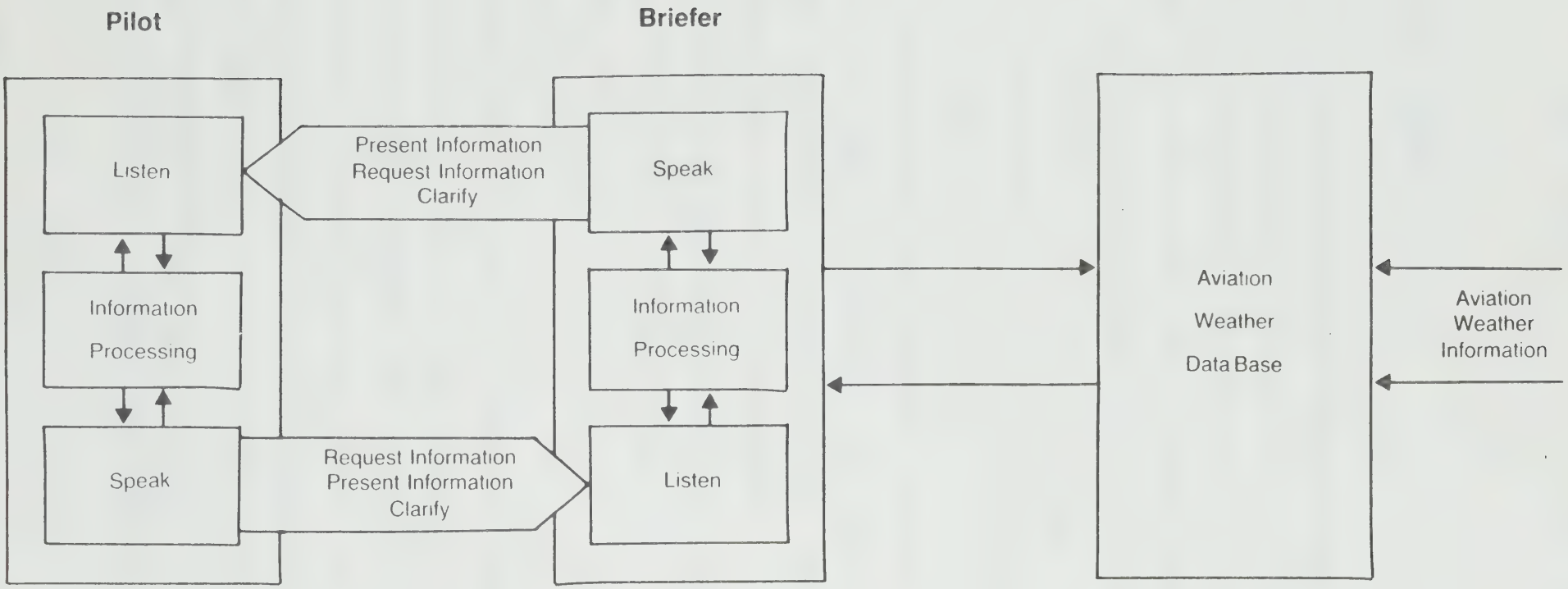

Figure 2. Schematic diagram of telephone briefing as provided by staff of Atmospheric Environment Service and Flight Service Stations.

5.0 Summary of Findings

5.1 Summary of the Conclusions from the Background Report

The following is a summary of the tentative conclusions that were included in the Background Report. As part of the overall assessment of TABS, subsequent research has added support to and clarified these conclusions. It should be noted, however, that the conclusions related to the accuracy, timeliness and reliability of TABS were associated with early stages of the trial and do not reflect subsequent efforts to make improvements in these areas.

- Based on usage studies of the telephone briefing services, there is a real need for a supplement to the currently available aviation weather services for pilots. These studies also indicate that all aviation weather services appear to experience considerable variability in demand. This variability makes it desirable to have a service that can respond to variations in demand in a flexible, but cost-effective manner.
- According to interviews with pilots and briefers, aviation weather services are used for a variety of reasons: for route briefings (most frequently), for preliminary briefings to make go/no go decisions, for weather updates, for training purposes, and for area briefings. These interviews suggest that each reason requires access to different information. Thus, aviation weather services need to be sufficiently flexible so that pilots can obtain needed information

efficiently.

- Interviews with pilots and briefers also indicate that TABS is being used to supplement existing weather services, for training purposes, or to get a preliminary briefing before telephoning one of the other services for a full briefing. TABS also supplements the telephone services by providing an airport-located backup if pilots cannot reach a briefer by telephone.
- Quality assurance studies of TABS identified problems with the accuracy and especially the timeliness of the information in the TABS database. In some cases, there have been problems keeping TABS terminals operational at the airports. Subsequently, efforts have been directed at making improvements in these areas.
- Aviation weather services should give pilots the information they need quickly.
- Most pilots do not find it very difficult to use the TABS terminals. Rather the problems of pilots appear to center around their inability to understand the weather information they are presented with and to understand its relevance to their planned flight.

5.2 Summary of the User Survey

The survey was designed to obtain feedback from TABS users and from non-users regarding their use of, and attitudes toward TABS and other aviation weather services.

The sample included 164 pilots of which 46 were not users. Most users had obtained a TABS briefing within one month of being surveyed. Approximately half of the TABS users had used the system more than 15 times. Users varied considerably in age, license type, flying frequency and type of aircraft. Because overall ratings and usage of TABS were not significantly related to pilot characteristics, survey results are reported for pilots as a group. Non-users knew very little about TABS. This result suggests that people not currently using TABS are unaware of it rather than avoiding it.

The surveyed pilots indicated that the introduction of TABS had reduced their use of the other aviation weather services and had reduced the number of times they received no weather briefing at all before flying.

The overall reaction to TABS is favorable, with 69% of users rating it good or excellent. There are also positive ratings of the type of information available on TABS, the format of the pages, the features that affect interactions with the system and the electronic and printed support materials. Concerns were expressed, however, about the timeliness of the information, the speed of the system, the lack of personal contact, the hours of operation, and the need to wait in line.

The survey was conducted in the summer of 1985 and does not reflect subsequent changes to the system. In particular, TABS was relatively slow when the survey was conducted. Since that time efforts have been made to improve the speed, accuracy, and timeliness of the system.

Pilots indicated that TABS is used most frequently by itself, although some pilots reported that they sometimes use it in combination

with the other aviation weather services, particularly the telephone services. Results also indicate that, in general, pilots prefer to use TABS over other aviation weather services when preparing to take a local flight, for flight training, or to find out about weather conditions (out of curiosity, or to expand or update a prior briefing), but there is no clear preference when planning an itinerant flight (from one location to another) or when making a go/no go decision.

In comparison to the telephone services, TABS receives similar ratings in terms of usefulness, amount and type of information, ease of use and time to begin a briefing session. Telephone services are rated higher in the accuracy and timeliness of information, time to learn the system, briefing time and reliability.

Pilots were given a list of 19 potential enhancements and asked to indicate the extent to which each enhancement would encourage or discourage their use of TABS. The five enhancements rated as "very much" encouraging use were the ability to file a flight plan using TABS; the ability to obtain a printed copy of weather information; an automatic warning if the filed flight plan may involve risk; the ability to use TABS from home; and displays that show the movement of weather systems.

The following enhancements were also rated as likely to encourage use: briefings tailored to specified routes; TABS terminals in more airports; information for Canada and North America; additional radar sites; the ability to use TABS from business locations; computer-based refresher courses; and the ability to select three upper-level winds.

Other possibilities not given significantly positive ratings were: audio information to supplement the visual information; simpler

keyboards; global weather information; weather information for North and South America; and information about weather above 18,000 feet.

5.3 Summary of the Pilot Performance Experiment

The pilot performance experiment investigated in a controlled situation to what extent pilots can use TABS to make good, informed decisions as compared to pilots who use audio-taped briefings that are tailored to their needs.

Specifically, the experiment examined to what extent pilots make appropriate go/no go decisions, and have the detailed information necessary for planning and carrying out a flight after receiving either a tailored or a TABS briefing. The experiment also investigated how long it takes pilots to obtain this information and whether performance after using TABS was affected by the nature of the weather conditions.

A total of 40 pilots participated in the experiment. The pilots had a wide range of flying skills and had used TABS at least five times. Each pilot was given a single briefing describing the weather conditions on 1 of the 4 days used in the experiment. The same days were used in both briefing conditions. Half the pilots briefed themselves using a simulated TABS system. The other half received a tailored briefing which was based on information available from the simulated TABS system and was presented using audiotape.

The weather on these days varied from a straightforward VFR condition, to a marginal VFR condition, to a day unacceptable for a VFR flight. (VFR, visual flight rules, call for skies that are clear enough to fly without the use of instruments.) The differences discussed below

are statistically significant unless otherwise indicated.

In making a go/no go decision, pilots in both the TABS and tailored briefing conditions were able to make decisions that agreed reasonably well with the decisions of experts for all weather conditions tested in the experiment.

However, when asked a series of basic aviation weather questions related to their flight, pilots in the TABS condition had substantially less detailed information relevant to a hypothetical, itinerant flight than pilots in the tailored condition. This difference was observed for all types of weather conditions and for many different types of information.

Pilots using the simulated TABS system also took substantially longer to brief themselves than pilots in the tailored briefing condition. This result was obtained for all weather days.

In a follow-up to the study, it was determined that pilots, on average, understand 88% of the information on SA/FT pages. SA/FT pages present, in abbreviated form, the most up-to-date and detailed information about weather conditions at airports. Requests for these pages constitute approximately one third of all page requests made on TABS.

The report concludes tentatively that pilots using TABS may make reasonably effective go/no go decisions, but they may not have all the detailed information they require to effectively plan or execute their flight. It is proposed that TABS users may have difficulty in selecting and/or remembering information relevant to their intended flight. This explanation leads to a discussion of the potential benefits of tailored briefings as a TABS option, paper copies of TABS information pages as a

memory aid and computer-assisted instruction in the use of TABS.

6.0 Conclusions

This section draws conclusions from the results of this assessment which are relevant to future work on TABS and other aviation weather briefing services.

The conclusions and recommendations that follow were developed with help from Dr. Wayne Stevenson, an expert in aviation and meteorology, and Dr. Ron Elliott, an expert in computer systems.

6.1 Use of TABS

Results of the TABS User Survey indicate that TABS use could be increased by modifying the service and by increasing awareness of its availability and the nature of the service. The survey report identifies a number of modifications that may encourage its use and suggests what types of pilot needs may be especially well served by TABS. Responses of non-users indicate that they tend to have relatively low awareness of TABS.

6.2 Accessibility of Aviation Weather Services

Demand for aviation weather information is not being met by the existing services. Results from the TABS User Survey indicate that the introduction of TABS decreased the likelihood that pilots flew without obtaining a weather briefing. The survey also indicated that "getting a busy signal" discourages use of the telephone briefing services. These findings suggest that increasing the accessibility of TABS would increase the likelihood that pilots will be briefed before flying. There is a need for increased access to aviation weather services.

6.3 Pilot Performance

Results from the pilot performance experiment indicate that pilots using TABS make effective go/no go decisions but do not have as much detailed information about weather conditions as pilots who are given an audio-taped briefing tailored to their needs. These results suggest that pilots who brief themselves using TABS or a similar self-briefing system may not have all the detailed information they require to effectively plan or execute their flight. The pilot performance study also indicates that audio-taped briefings may be both practical and effective.

The results of this study suggest that new methods of delivering aviation and weather information may affect the safety of the pilots using them. These results reinforce the need to evaluate the impact of any new system on the safety of pilots.

The implications of this study indicate a need for further research to better understand how pilots use TABS to plan and make flights. In addition, the research should investigate methods of improving pilot performance by training them and by modifying TABS.

New methods of delivering weather information could also be adapted to offer courses that will teach pilots to effectively use aviation weather briefing services. There appears to be a need for more effective instructional materials for current and potential TABS users. More details related to this opportunity are provided in the pilot performance report.

The results of the Study of Pilot Performance suggest that TABS' effectiveness could be enhanced by developing an additional, interactive

option. By asking a pilot the type of flight (VFR/IFR), the type of aircraft, the estimated departure and arrival times, and the takeoff and destination airports, TABS could prepare a tailored briefing. Some potential advantages of such a feature include:

- Pilots can be briefed more quickly because they will spend less time reading information irrelevant to their flight and will not spend their time deciding what information is required for their flight.
- Pilots may come away from such a briefing with a more detailed understanding of the relevant weather conditions.

The TABS User Survey indicates that tailored briefings would also encourage more frequent use of TABS.

6.4 Time to Obtain a Briefing

Pilots surveyed in the summer of 1985 indicated that they were discouraged from using TABS because of the time it takes to brief themselves. Major time-related concerns were how long it takes to sign on, and how long it takes for pages, particularly graphics pages to display.

The concern about sign-on time may be pronounced because pilots spend up to a minute signing onto TABS but often spend only 5 minutes using the system. The time it takes for a page to display varies widely from about 20 seconds for an SA/FT page to 60 seconds or more for a page with graphics. There are a number of ways to speed up the display of pages. One possibility would be to store information that does not change (e.g., map backgrounds) locally. Alternatively, the rate at which pages are transmitted from the central computer to the terminal could be

increased.

Although both of these changes would speed up the display of information on TABS, it is difficult to know to what extent either alternative would substantially shorten a briefing because, at this point, it is not known whether the additional time spent on TABS (as compared to a telephone briefing) is attributable to display times, or to the time pilots spend sifting through the pages and identifying relevant information.

6.5 More Functionality on TABS

Results from the TABS User Survey indicate that the following additional capabilities may encourage the use of TABS:

- File a flight plan. This capability could enhance the efficiency of the aviation weather services. Currently pilots using TABS must call or make a personal contact with FSS before flying.
- Obtain a printout of the weather information. This capability could enhance safety because it would permit pilots to carry onto the airplane an accurate record of weather conditions for review during the flight.
- Receive an automatic warning if the filed flight plan is dangerous. While this feature is potentially quite valuable, a potential drawback is that pilots may come to rely upon it as a "crutch" and may not exercise their own judgment.
- See more effective depictions of weather movement to assist pilots in determining weather trends.

6.6 More Information on TABS

The TABS User Survey indicates that including the following types of information on TABS may also encourage the use of the system:

- Canadian and American weather.
- Radar information from additional sites.
- Upper level winds.

6.7 System Performance of TABS

There were system performance problems with TABS when it was examined in the summer of 1985. Specifically, the central computer was partially or completely out of order on occasion, terminals at some airports were out of order and information on TABS was not always accurate and up-to-date. Although subsequent efforts have been aimed at making improvements in these areas, these problems reinforce the need to monitor system performance.

6.8 SA/FT Pages

Results from the Study of Pilot Performance showed that when pilots can refer to an SA/FT page, they, on average, answer correctly 88% of questions related to that page. However, since about one third of the page accesses are to these pages, the finding of a 12% error rate is still of some concern. Further research should be undertaken to improve the presentation format of the information on these pages.

6.9 Designing Aviation Weather Services Involves Tradeoffs

Future decisions concerning TABS and other aviation weather services will involve tradeoffs. Some tradeoffs evident from this project include:

- allocating funds to maintain or increase the availability of TABS versus funding efforts to improve TABS and/or develop improved training systems for TABS users;
- allocating funds for the development and delivery of TABS versus allocating funds for other aviation weather briefing services; and
- adding functionality to a service (e.g., by adding printers or making terminals more intelligent) versus keeping systems simple to control maintenance and reliability problems.

7.0 Recommendations

This section provides a series of recommendations beginning with a general statement about the need for systematic and coordinated planning for TABS and including a number of specific recommendations related to the following issues: performance standards for briefing services; modifications to TABS; training for TABS users; accessibility of TABS; awareness and use of TABS; modifications to telephone briefing services; and the need for additional research and development related to briefing services. Recommendations are based on the assessment research summarized in this report. The recommendations are aimed at improving the design, development, and implementation of safe, effective and efficient aviation weather services. In considering these recommendations, it should be kept in mind that the assessment focused on human factors and did not examine other important factors that need to be considered when arriving at decisions concerning the future development of TABS. For example, the assessment did not examine the efficiency or cost-effectiveness of TABS in relation to the other aviation weather services, it did not study all of the other alternative services, and did not assess the likely cost-effectiveness or the technical feasibility of proposed service modifications.

Recommendation 1. Establish a planning and priorities committee whose primary responsibilities are a) to develop and implement a systematic and coordinated method for considering future options for TABS and b) to decide what effects these options would have on the safety, effectiveness, and efficiency of aviation weather services. Factors considered by the committee would include relevant policy considerations, funding

requirements and limitations, tradeoffs, human factors, and technical feasibility.

Recommendation 2. Where it is not already being done, establish performance criteria related to the operation of aviation weather briefing services, and develop and implement procedures for ensuring compliance. Areas where standards are required would include: accessibility, information content, accuracy of information and timeliness.

Recommendation 3. Consider the following potential improvements and enhancement to TABS:

- tailored briefings as an optional feature;
- ability to file a flight plan through TABS;
- automatic warning if a filed flight plan would expose the pilot to unacceptable risks;
- ability to obtain a paper copy of any TABS page during the self-briefing process;
- displays showing the movement of weather systems;
- SA/FT pages that present information in standard, non-abbreviated English to substitute for or complement current SA/FT pages;
- weather information for Canada and the U.S.A.;
- weather information from additional radar sites; and
- weather information related to upper level winds.

Recommendation 4. Consider improved methods for training pilots to use TABS and other briefing services (e.g., incorporating optional user feedback into briefing, and computer-assisted instruction).

Recommendation 5. Consider methods for improving the responsiveness of

TABS (e.g., faster access to service and shorter time to display complex pages). The evaluation should consider the impact on total briefing time, on effectiveness of the briefing and on the tendency to use TABS. The results of this effort could lead to the development of performance criteria related to the responsiveness of TABS.

Recommendation 6. Consider increasing accessibility of TABS by installing terminals in more airports and by allowing home, business or airport access through personal computers.

Recommendation 7. Consider initiatives to increase awareness and use of TABS and to improve pilot understanding of the nature of the briefing service it provides.

Recommendation 8. Consider the following potential improvements to the telephone briefing services:

- a separate telephone number for filing flight plans only;
- telephone access to tailored audio-taped briefings so that briefers do not have to repeat the same briefing to several different pilots; and
- a queue feature so that pilots can call a service once and be served in order (while waiting, pilots could hear a brief message regarding the availability of TABS and could be given an estimate of how long they may have to wait for a telephone briefing).

Recommendation 9. Consider continued evaluation of the effectiveness of TABS and of any potential improvements to the system. One goal of this research would be to provide a better understanding of how pilots use TABS to brief themselves, to plan their flights, and to make decisions

during a flight.

Recommendation 10. Consider continued efforts to identify and assess the safety, effectiveness, and efficiency implications of current and potential future briefing services.